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## Why solar radiation management geoengineering and democracy won't mix

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**Abstract.** In this paper we argue that recent policy treatments of solar radiation management (SRM) have insufficiently addressed its potential implications for contemporary political systems. Exploring the emerging 'social constitution' of SRM, we outline four reasons why this is likely to pose immense challenges to liberal democratic politics: that the unequal distribution of and uncertainties about SRM impacts will cause conflicts within existing institutions; that SRM will act at the planetary level and necessitate autocratic governance; that the motivations for SRM will always be plural and unstable; and that SRM will become conditioned by economic forces.

**Keywords:** solar radiation management, geoengineering, governance, politics, democracy, social constitution of technology

### Introduction

Solar radiation management (SRM) techniques are proposed interventions into the planetary climate system aimed at counterbalancing the excess heat generated by rising concentrations of greenhouse gases by reflecting some of the inbound solar radiation back into space. In recent years these and other 'geoengineering' proposals have been presented as providing a third policy route for responding to climate change, alongside mitigation and adaptation. In this paper we focus on one class of SRM proposals that involve the injection of sulphates and other types of particle into the stratosphere. It is these techniques in particular that have been described as potentially 'affordable' and 'effective' in policy literature (Royal Society, 2009, page 31) and as warranting research attention (Nurse, 2011), and that have generated the most policy and scientific deliberation (American Meteorological Society, 2009; Bipartisan Policy Centre Task Force on Climate Remediation Research, 2011) and controversy (ETC, 2010).

SRM research is currently confined largely to the development of theoretical models and simulations. However, in advance of any full-blown research effort, a policy consensus has emerged in recent years that gives a cautious warrant to exploring the feasibility, safety, and efficacy of SRM while at the same time preparing for any potential future deployment by developing forms of anticipatory governance guided by principles of global cooperation, public participation, institutional transparency, and independent assessment (Bracmort et al, 2011; Rayner et al, 2010; Royal Society, 2009; SRMGI, 2011).

Current discussions around the details of SRM governance are complex and diverse. However, there are still some crucial questions raised by SRM that are not receiving the attention that they deserve, the answers to which could potentially problematise the notion that SRM is even a candidate for being democratically governed. In particular, we will argue that there is an urgent need to make explicit the particular way in which SRM is being constituted as a technology, to interrogate the embedded assumptions and sociopolitical implications of this constitution, to question whether it might encourage forms of politics that may be incompatible with democratic governance, and to explore the specific challenges that SRM might pose to democracy itself.

By 'democracy' here we are referring not to any particular ideal model of social organisation, but to a heterogeneous set of subnational, national, and supranational practices, principles, and institutions that serve to constitute citizens as part of a collectivity, able to act freely and equally, either directly or through elected representatives, in the practice of political self-determination. These include, but are not exhausted by, political pluralism, free and fair elections, equality before the law, protection of civil liberties, freedom of speech, sovereignty of national governments, ability to get redress for harm through legal systems, a minimal level of human rights, and a functioning civil society. The lack of progress in achieving an effective transnational climate change mitigation agreement has already put the legitimacy of democratic processes under strain, contributing to the danger of a postpolitical or postdemocratic condition where ideological conflict and dissent are replaced by a set of depoliticised, despatialised, expert-led discussions revolving around the management, monitoring, minimising, and fetishisation of CO<sub>2</sub> (Swyngedouw, 2010). We argue that SRM geoengineering is likely to intensify this kind of dynamic, generating an unprecedented set of challenges for democracy.

### Technology and politics

What does it mean to say that a technology might have political effects? In a famous paper, Langdon Winner distinguished two ways in which technologies can be political (Winner, 1980). In the first, a technology or device can be *made* political, by being deliberately designed, or unconsciously selected, in order to produce a particular set of political consequences. For example, the introduction of new manufacturing plant might be used to weaken the power of organised labour in a factory (pages 124–125). In the second, certain technologies can be seen as *inherently* political, in that they require, or are at least strongly compatible with, a certain way of organising social relations around that technology, or even in society at large. Thus the atom bomb can be seen as a technology that requires centralised chains of command and high levels of surveillance, features that can threaten to spill over onto the wider polity (page 131).

Winner's argument has been criticised for understating the contingency of the social relations that they imply (eg, Johnson, 1988). Nevertheless, empirical research suggests that people's responses to existing emerging technologies are shaped by the social worlds that they seem to connote. Comparing the social constitution of information technologies (IT) with genetic modification (GM) technologies, for example, Grove-White et al (2000) found that the consumer benefits of IT were typically seen as visible, authentic, familiar,

personally empowering, and responsive, while those of GM were seen as invisible, indirect, questionable, remote, artificial, and involuntarily imposed.

In this paper we argue that it is fruitful to analyse SRM through stratospheric aerosol injection as falling into Winner's second category of political technology: as a form of technology which is 'inherently political' in the sense of being unfavourable to certain patterns of social relations and favourable to others.<sup>(1)</sup> Below, we argue that there are at least four reasons why the emergent social constitution of forms of SRM that rely on stratospheric aerosol injection should be judged as posing serious challenges to democracy.

### **Uncertainties inherent in SRM will cause conflicts within existing institutions**

The prominence of SRM in debates about geoengineering is based largely on the idea that it could be 'cheap and effective' compared with both carbon mitigation strategies and other geoengineering techniques (Barrett, 2008; Klepper and Rickels, 2012; McClellan et al, 2012). Such assessments, however, make the crucial assumptions that the impacts of SRM interventions on the climate will be in line with those predicted by climate models, and that subsequent political discussion and deliberation will operate within these parameters. However, SRM geoengineering has a distinctive relationship with uncertainty that problematises such assumptions. With most previous technologies that have been subject to regional and global governance and control (eg, persistent organic pollutants and CFCs), it is the *side-effects*, often after decades of use, that have been of concern (European Environment Agency, 2001). Such side-effects have typically been hard to predict or attribute, but research has increased certainty to a sufficient degree as a basis for global action, often underpinned by a degree of precaution, making possible both hard and soft governance arrangements (ranging from codes of conduct to globally negotiated treaties). But with geoengineering technologies such as SRM the task of governance is significantly different: it is the *intended effects* [for example, a reduction in global temperature] that are global; that may only become apparent over long timescales; and that are probabilistic and highly mediated, since they involve affecting technological and statistical constructs such as 'global average temperature' through intervening into an earth system which is highly chaotic and always in formation (Galarraga and Szerszynski, 2012)]. Deployment will thus always have the character of research (cf Krohn and Weingart, 1987; Macnaghten and Szerszynski, 2013).

These features of SRM geoengineering as it is being constituted are likely to raise a number of challenges for democratic institutions and processes. Firstly, the difficulty in modelling climate processes means that it is almost certain that any SRM intervention would not compensate for greenhouse-gas-driven climate change in any straightforward way. SRM interventions will produce novel climate configurations, with both winners and losers, raising complex issues of justice and redistribution. If the climate resulting from an SRM intervention is more unruly than that predicted by geoengineering researchers, the ensuing politics is also likely to be of a different level of disorderliness.

Secondly, the indeterminacy that is endemic to atmospheric and climatic phenomena would mean that the attribution of cause and effect, and of liability and accountability, would be impossible to carry out in any definitive way—even in principle. Local-scale testing of technological options would be unlikely to produce convincing results, because of the difficulty in distinguishing signal or noise in any particular experiment (Robock et al, 2010). After any large-scale deployment of SRM technology, any subsequent unusual weather event—and its consequences for human life and economic activity—would become an object

<sup>(1)</sup> It is important to stress that our argument pertains to stratospheric aerosol injection variants of SRM rather than to 'softer' variants of SRM, such as 'ice water' and 'ice 911', that in principal at least, can be applied locally and which have rapid reversibility (see Olson, 2012). These 'softer' versions may imply very different forms of social organisation.

of fierce contestation due to the difficulties in attributing cause and effect (Hulme, 2010; Hulme et al, 2011). Any system of compensation for SRM effects would depend on the use of computer models in order to determine what form the climate would have taken if SRM had not been used, which would be subject to the same kind of uncertainties and indeterminacies involved in modelling SRM interventions, problematising any clear classification of winners and losers.

Thirdly, all of this would impact on the broader politics of climate change. Any institutions and processes that are charged with mediating between the interests of societies and social groups which have differentially benefited from or been harmed by the growth in fossil fuel use over the last two centuries nations would be likely to be put under increasing strain as SRM technologies move into real-world application. What Paul Edwards (2010) calls the ‘vast machine’ of computer models, meteorological monitoring instruments, and scientific protocols which constitute weather and climate as objects of knowledge would also be likely to become even more politicised than it is at present. SRM deployment would thus make the politics of climate change mitigation even more difficult.

### **SRM will act at the planetary level and necessitate autocratic governance**

There are also reasons to think that SRM will favour closed forms of decision making. Because of its deployment at the planetary level, decisions would be taken at that level and over considerable timescales, giving little opportunity for opt-out or dissent. Given the undoubted sensitivities that would underpin its use, and the highly mediated nature of the effects of SRM, it could generate a closed and restricted set of knowledge networks, highly dependent on top-down expertise and with little space for dissident science or alternative perspectives. Furthermore, the complexities that would accompany the climate modelling would ensure that expertise would remain minimally distributed and personally remote. The idioms surrounding discussion over its use would remain, at least at first, expert led and opaque. In the face of a future ‘crisis’, it would be difficult to imagine how public responses could be directly involved in developing solutions; more likely, solutions would be imposed and pervasive. Finally, given SRM’s inevitable reliance on a limited number of techniques and sites of application, it is difficult to imagine a structure other than one in which SRM would be controlled by a centralised structure, relatively closed to influences that might disrupt its smooth running.

Other ways of constituting SRM are possible—for example, ‘soft geoengineering’ techniques with very different implied social relations (Olson, 2012). But SRM geoengineering is largely being constituted in a way that involves the choreographed deployment of large-scale interventions that will act on the global scale to produce global effects that are agreed (at least by some) in advance. It is difficult to imagine how this social constitution could be compatible with a pluralist and democratic politics. If this description is accurate, the social constitution of SRM geoengineering through stratospheric aerosol injection would be strongly compatible with a centralised, autocratic, command-and-control world-governing structure, in tension with the current, broadly Westphalian, international system based on national self-determination.

### **The motivations for SRM will be plural and unstable**

The important role played by intent in SRM geoengineering raises further problems for democratic governance. Questions of intent have been central to the political processes shaping the constitution of SRM as a technology (Stilgoe, 2011). The formal definition of SRM, like that of geoengineering in general, is tied to the goal of offsetting anthropogenic climate change. Whether or not a specific action such as releasing particles into the upper atmosphere counts as SRM geoengineering deployment, or as research, or even as mere



pollution cannot be determined by a mere technical procedure, but only by reference to intent. This implies that meaningful geoengineering governance would logically require the scrutiny and regulation of the intentions, whether explicit or implicit, of a huge range of research and deployment activities, raising significant logistical and political questions.

Furthermore, aside from the general assertion that geoengineering be 'regulated as a public good' and in the public interest (Rayner et al, 2010), policy reflection on intentions and motivations has insufficiently considered the way that intent in SRM geoengineering is likely to be unstable and open to plural interpretations. Firstly, even the intended consequences of SRM are themselves not necessarily unproblematic, not least since good intentions can lead to perverse outcomes, particularly at scale. Secondly, due to the problem of the attribution of consequences in climate processes discussed above, there will not necessarily be consensus that any realised goal of SRM was indeed brought about by its deployment. Thirdly, what constitutes a 'good' motivation is itself likely to become the subject of contestation. The framing of SRM as a means of counteracting anthropogenic climate change is likely to be joined or displaced by alternative frames—for example, as a means to achieve humanitarian, environmental, nationalistic, military, or commercial goals.<sup>(2)</sup> This *instability of intent* is a key driver of scepticism about SRM amongst lay publics: participants in one study were convinced that SRM techniques would inevitably become used in ways that would be radically at odds with their original stated purpose (Macnaghten and Szerszynski, 2013).

The interpretive flexibility of intent in SRM research is likely to be vast. Whereas earlier global initiatives such as the removal of CFCs were easier to gain consensus around, it seems difficult to imagine how agreement on the exact goals of SRM technology could ever be reached and enforced, and the attribution of them to any specific deployment stabilised.<sup>(3)</sup> There are thus many reasons to suggest that with SRM the relationship between intention, deployment, and consequences will always be unstable, rendering problematic any claims of prior democratic consent and leading to new kinds of conflict and controversy.

### **SRM will become conditioned by economic forces**

Research into SRM geoengineering is likely to become framed by a powerful set of political and economic discourses and imperatives that are in tension with the imperative for democratic control. Such issues can be expected to become significant shaping factors in SRM research once deployment becomes more than a theoretical possibility; yet they are currently receiving little attention. The science and politics of SRM have so far developed through a particular and restricted assemblage of actors and ideas, with the result that policy and regulatory treatments of SRM have largely failed to acknowledge questions of political economy.

There have been accusations that advocacy for SRM geoengineering research is part of a project that aims to protect established political and economic interests by creating a rhetorical defence against more aggressive carbon reduction measures (ETC, 2010; Pielke, 2010; Steffen, 2009). Such arguments are perhaps overly simplistic, but it is nevertheless true that SRM geoengineering can be readily be co-opted by vested interests. Concern about the dangers of geoengineering research and deployment being shaped by sectional interests prompted Rayner et al (2010) to make the first of their five 'Oxford Principles' for geoengineering governance that geoengineering should 'be regulated as a public good'.

<sup>(2)</sup>For examples of the various uses to which SRM geoengineering may be directed, see Olson (2011) and Hamilton (2013).

<sup>(3)</sup>The dumping of 110 tonnes of iron sulphate off the Canadian coast in 2012, variously described as 'geoengineering', 'ocean restoration', and 'salmon enhancement', is a case in point—see <http://www.theguardian.com/environment/2012/oct/15/pacific-iron-fertilisation-geoengineering>

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Yet substantial economic opportunities are likely to be created by any plan to deploy SRM geoengineering, including: the patenting of specific SRM techniques or classes of techniques; the design of particles for release into the stratosphere; the design of delivery systems; the sourcing and transport of raw materials; the design and implementation of monitoring systems; and the establishment and running of financial schemes of funding and possible compensation. We should not be naïve about the significant economic interests which would thereby become involved.

More broadly, we should expect SRM to get caught up in the neoliberal project to extend the use of market mechanisms into more and more areas of economic and social life. At first glance, SRM seems an unlikely target of neoliberal attention, because of the way that its technical features, as discussed above, resonate with ideas of centralised, coordinated action based on agreed plans, scientific monitoring, and analysis. Yet SRM can also be seen as in step with a wider shift in contemporary scientific and environmental practice that has reconceptualised biological life, climatic dynamics, and biodiversity in informational terms (Cox, 2002; Hayden, 2003), and as new sites of financialisation and capital accumulation, using artificially created markets around various ‘fictitious commodities’ such as carbon or biodiversity (Cooper, 2010; Pryke, 2007). We should thus expect SRM to be drawn into such dynamics, ones which are no more compatible with collective, democratic forms of control than is autocratic centralisation (von Hayek, 1944).

Furthermore, the growing involvement of private sector interests in the development, deployment, and financing of SRM technologies could have problematic effects on the practice and authority of science. SRM geoengineering researchers may be forced to adopt difficult—often politicised—roles: in 2011, for example, the UK Stratospheric Particle Injection for Climate Engineering (SPICE) project decided to abandon their trial of an SRM delivery system, partly as a result of being made aware of the existence of a prior patent application involving one of the project team (Cressey, 2012). Imaginaries of deployment will inevitably start to influence the kind of questions that shape scientific research in this area; as has happened in other areas such as biotechnology and nanotechnology, the science of SRM is likely to get involved in promissory, ‘vision-based’ dynamics, creating ‘bubbles’ of investment, hope, and hype around possible future technologies. If deployment occurs, climate modelling, monitoring, and attribution processes will become even more politicised by being so closely implicated in financial products and calculations of profit, further weakening their political authority in other climate change arenas.

## **Conclusion**

We have argued that debates around the governance of SRM tend to neglect its political dimensions. In particular, we have suggested that the emerging constitution of SRM technology is likely to pose serious challenges to the processes and institutions of liberal democracy.

In this short paper we have been able to sketch out only some of these challenges. Firstly, the irreducible uncertainty of the regional and local effects of SRM, and the impossibility of any definitive attribution of causality and liability should extreme weather patterns develop, is likely to lead to increased conflict and strain on international relations and on associated institutions. Secondly, the deployment of technologies operating at the global scale will politicise the mutual interlinking of the climates of sovereign nations in a radically new way, creating new modes of technocratic internationalism. Thirdly, intention is at once so central to the constitution of SRM and so likely to be unstable that it will pose problems for the idea of informed consent within democratic polities and produce further conflicts. Fourthly, SRM technologies are likely to become conditioned by economic relations that are likely to further

remove control of SRM from collective democratic choice, and could start to shape the science behind it and undermine the latter's role in the brokering of democratic agreement.

We have argued that the regulation of SRM may in practice be likely to operate largely outside the orbit of the democratic processes that help ensure that policy decisions are made in the public good, and that the science guiding such decisions is robust. We have also argued that SRM deployment could put considerable strain on political systems and relations, making democratic decision making in other areas more difficult. For such reasons, more attention needs to be paid to the political implications of this technology-in-the-making.

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